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OFFICE OF NAVAL RESEARCH
END-OF THE-YEAR REPORT 1989
PUBLICATIONS/PATENTS/PRESENTATIONS/HONORS/STUDENTS
REPORT

for

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STOCHASTIC PROCESSES IN CHEMFETS

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Part I

a. Papers submitted to Refereed Journals (not yet published)

V.Marecek, M.Gratzl, A.Pungor and J.Janata, J.Electroanal.Chem. (1988) in print, Fluctuation Analysis of Liquid/Liquid and Gel/Liquid Interfaces

M.Gratzl and J.Janata, J.Phys.E. (1989) in print, Filter Banks for Power Spectrum Estimation With a Logarithmically Uniform Frequency Resolution

Ken-ichi Hongyo, A.A.Peterson, C.Bruckner, A.Bezegh, M.Gratzl and J.Janata, Langmuir, (1989) in print, Equilibrium Fluctuation Analysis of the Chemical Modulation of the Reactance of Bilayer Membranes

b. Papers Published in Refereed Journals

K.Potje-Kamloth, P.Janata, J.Janata and M.Josowicz, Sen.&Actuators 18 (1989) 613-623 "Electrochemical Encapsulation for Sensors" (other support: BMFT)

M.Josowicz and J.Janata, Solid State Ionics 28/30 (1988) 1625 "Polymer layers for Sensor Applications" (other support: Humboldt Stiftung)

J.Janata and A. Bezegh, Anal. Chem. 60 (1988) 62R, Chemical Sensors,

c. Books (Submitted for Publication)

J.Janata, Principles of Chemical Sensors, Plenum Publishers, 1989 (textbook, 320 p.)

J.Janata, Proc.ElectroFinnanalysis, Turku, June 6, (1988), Solid State Potentiometric Sensors (Other Support: Humboldt Stiftung) in

print

d. Books (Published) none

e. Technical Reports

4 ONR Technical Reports

J.Janata, A Bezegh and A.Pungor, Bibliography of Chemical Sensors 1985-1987, Published by CST Utah, 1988

f. Patents Filed

One patent applied for in 1989: Author: M.Gratzl, Title: Filter Banks for Power Spectrum Estimation With Logarithmically Uniform Frequency Resolution

g. Patents Granted none

h. Invited Presentation at Topical or Scientific/Technical Society Conferences

Int. Conference on Electroanalysis, Turku, Finland, June (1988), Solid State Potentiometric Sensors

J.Janata and C.C.Durney, Chemical and Magnetic Field Resonance Modulation of Membranes, Gordon Research Conference, Colby Sawyer, June

J.Janata, Chemical Modulation of Work Function, Workshop on Solid State Chemical Sensors, Schloss Ringsburgh, West Germany. Sept.

J.Janata, Ions to Electrons, Int, School of Pure and Applied Biostructure, Erice, Italy, December

A.M.Riley and J.Janata, Chemical Modulation of Work Function as New Sensing Principle, Joint US/Japan Symposium, April, Hawaii

P.Topart, A.M.Riley and J.Janata, Factors Influencing
Quartz Crystal Resonators in Liquids, Joint US/Japan Symposium,
April, Hawaii

i. Contributed Presentations at Topical or Scientific/Technical
Society Conferences

none

j. Honors, Awards, Prizes

none

k. Number of Graduate Students Receiving Support

Duan Fu Hsu

Patrice Topart

Tian-Hong Zhang

l. Number of Postdoctoral Associates

A. Riley (partial support)

M.Gratzl

Part II

- a. Principal Investigator: Jiri Janata
- b. Cognizant ONR Scientific Officer: Robert Silverman
- c. Telephone Number: (801) 581 3837

- d. BRIEF

The main goal of this period was to develop the technique of equilibrium fluctuation analysis and to apply it to electrochemical problems. In the last year we have extended the fluctuation analysis to study of the liquid/liquid interface and of phospholipid bilayer membranes. These studies were done with a discrete amplifiers as opposed to FETs used before.

Approximately 15% of funds in this period were used to initiate research into chemical modulation of work function of synthetic metals results of which form the basis of our new proposal. The equilibrium fluctuation analysis will be heavily used in the next phase of our work.

e. SIGNIFICANT RESULTS

We have shown that equilibrium fluctuation analysis offers a fundamentally different approach to characterization of dynamic properties of various electrochemical systems ranging from fast redox couples, to liquid/liquid interface, bilayer membranes and even insulator/solution interface. This technique allows the study to be done under the conditions of true equilibrium. It is possible to carry out impedance measurements approximately one decade below that normally used in AC impedance analysis.

The representation of power spectra on logarithmic scale of frequencies without distortion has been developed. Because this is a new approach to digital filtering we have applied for a patent protection.

Chemical modulation of work function of new electronic

materials has been identified as an important factor which has to be considered in application of materials such as synthetic metals. Our preliminary study shows that a rigorous control of electropolymerization conditions can produce materials of widely different work function.

f. SUMMARY OF PLANS

The relationship between work function and conditions of electrochemical preparation of synthetic metals will be investigated. This will include the effect of the applied potential during the polymer growth as well as the ion exchange during the relaxation period. We will try to elucidate the mechanism of ion exchange (doping) using equilibrium fluctuation analysis developed during the previous period of this contract. This will also yield the value of resistivity of thin films under "wet" conditions. The principal technique for for assessment of the "quality" of these materials in all stages of their investigation will be the Kelvin probe. It is expected that this study will highlight the importance of WF as the key property for any electronic applications of these materials.

g. Graduate Students and Postdocs to be Supported Postdocs:

A. Riley (partial)
M.Gratzl

Grad. Students:

S.Hsu
Tian-Hong Zhang (partial)

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